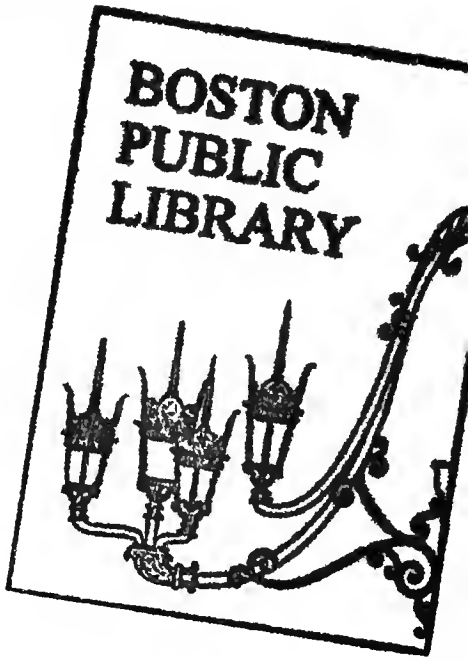
INCOME POTENTIAL AND REGIONAL PRODUCT PROJECTIONS
HISTORICAL ANALYSIS
ILLUSTRATION OF METHODOLOGY AND CALCULATIONS

Boston City Planning Board


ACCO PRESS
GENUINE PRESSBOARD BINDER
CAT. No. BG 2507
ACCO
CHICAGO.
LONDON.
GOSHEN, N.Y.
TORONTO.
MEXICO, D. F.

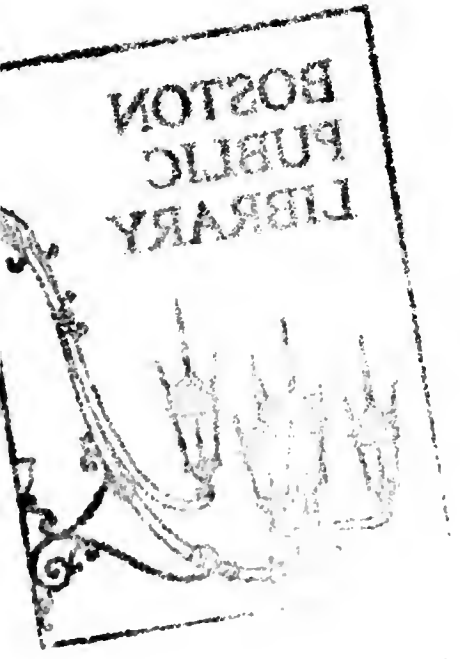
INCOME POTENTIAL AND REGIONAL PRODUCT PROJECTIONS
HISTORICAL ANALYSIS
ILLUSTRATION OF METHODOLOGY AND CALCULATIONS

Economic Series -- Staff Report #2



Basic Studies Section
Research Division
BOSTON CITY PLANNING BOARD

November 12, 1958.



PREFACE

The purpose of this report is twofold: On the one hand, it is intended to indicate the basic direction of the research staff in projecting future levels of the Boston economy and, as such, is proper material for critical review by the City Planning Board staff and outside professionals in the area.

The other purpose of the report is to provide the members of the research staff with a working tool: a specific model showing in detail the work to be carried out in performing the projections suggested herein.

As a result, the two objectives tend to impinge on each other. For review purposes, the report is perhaps wanting in explanatory text involving discussion of principals and reasoning. In addition, it might seem overburdened with mathematical (or arithmetical) detail.

As a working tool for research staff use, the report does not anticipate a number of problems which are sure to come up in the course of developing the analysis. One certain problem will be that of data, especially with regard to data for regional product and average productivity, where some sort of estimating techniques may have to be developed. Another is the boundary determinations of regional breakdowns in the national economy which will make most sense for the Boston area.

Accordingly, the report primarily serves as a preliminary statement of work program, and critical comments and suggestions are most emphatically welcome.

DESCRIPTION OF METHODOLOGY FOR INCOME POTENTIAL AND REGIONAL PRODUCT PROJECTIONS

1. BASIC REFERENCE MATERIAL

The basic derivation of theanalysis described herein is found in the following reference:

> Walter Isard and Guy Freutel, "Regional and National Product Projections and Their Interrelations," Long Range Economic Projection, Studies in Income and Wealth, Vol. 16, National Bureau of Economic Research, Princeton University Press, 1954.

2. FUNDAMENTAL RELATIONSHIPS

The analysis derived on the following pages is primarily dependent on the relationship that the average value of product for each worker in the economy times the number of workers gainfully employed yields the total value of product for the economy. Thus, the basic formulation utilized is as follows:

$$GNP = T \cdot L$$

where GNP is Gross National Product
T is average labor productivity per worker
L is the number of workers employed

3. CHANGES IN VALUE OF NATIONAL PRODUCT

From the above formulation, it can be seen that changes in national product are directly dependent on changes in the number of workers employed and in average productivity per worker. The latter factor, of course, is primarily tied to technological innovation and change leading to increased efficiency. Also involved in this would be changes in the value of the dollar, but this effect can be eliminated by adjusting past data to constant dollar values. Changes in employment are basically involved in changes in population. Such changes affect the demand for products and influence the level of employment required to sustain the population.

Thus change in GNP can be expressed as follows:

$$GNP_1 = L_0 (1 + p) \cdot (1 + z) \quad T_0$$

Where GNP, L, and T are as above and:
p is the rate of growth of the population
z is the rate of change of productivity, and
"0" represents the initial year while "1" represents the projected year.

4. REGIONAL PRODUCT

For the above formulations, which represent an aggregate of the national economy, regional breakdowns can be introduced utilizing the same formulation.

Rates of change indicated above can relate regional variations rather than national and the formulation would be as follows:

$$_{i}GRP_{1} = {}_{i}L_{0} \ (1 + {}_{i}P) \ (1 + {}_{i}T_{0})$$

where $_{i}GRP_{1}$ is the Gross Regional Product for Region "i" in the year 1

$_{i}L_{0}$ is the Labor Force for Region "i" in the year 0

$_{i}T_{0}$ is the average productivity for Region "i" in the year 0

$_{i}P$ is the rate of population growth for Region "i"

$_{i}z$ is the rate of change of average productivity for Region "i"

And from this, the sum of all regional products would make up the total national product, or:

$$GNP = {}_{1}GRP + {}_{2}GRP + \ldots\ldots\ldots + {}_{n}GRP$$

where $_{1}GRP$ is the Gross Regional Product for Region 1

$_{2}GRP$ is the Gross Regional Product for Region 2

$_{n}GRP$ is the Gross Regional Product for the "n'th" region in the economy.

5. PRODUCT DERIVED FROM DIFFERING ACTIVITIES

Having broken down Gross National Product into regional parts, further subdivision of the economy is possible by breaking down each region's economy into the basic activities which make up the economic community. For this analysis a subdivision into primary, secondary and tertiary activities is utilized. This is the standard economic classification where primary activities refer to extractive operations (agriculture, mining, etc.); secondary activities refer to processing operations (primarily manufacturing); and tertiary activities refer to service operations (transportation, utilities, communications, banking, finance, etc.).

The product for each activity category can also be formulated in the same manner as the total regional or national product with one exception. Rates of change of employment between primary, secondary and tertiary activities are not necessarily the same. In fact evidence seems to indicate that as an economy matures employment shifts from primary into secondary activities. Further maturing involves a greater degree of specialization and employment shifts again into tertiary activities. Thus the relative rate of shift into or out of each activity category must be accounted for, as follows:

$$_{i}GRP_{1_1} = {}_{i}L_{1_0} \ (1 + {}_{i}p)(1 + {}_{i}r_{1})(1 + {}_{i}z_{1})_{i}T_{1_0}$$

Where: $_iRP_{1_1}$ is the regional product of primary activities in region "i" in the year 1.

$_iL_{1_0}$ is the labor force employed in primary activities in region "i" in the year 0.

$_ip$ is the rate of growth of the population of region "i"

$_ir_1$ is the rate of shift into or out of primary activities in region "i"

$_iz_1$ is the rate of change of productivity of primary activities in region "i"

$_iT_{1_0}$ is the average productivity per worker in primary activities in region "i" in the year 0.

It follows from this that the gross regional product is the sum of the three basic activity products:

$$_iGRP_1 = {}_iRP_{1_1} + {}_iRP_{2_1} + {}_iRP_{3_1}$$

where $_iGRP_1$ is the Gross Regional Product in the Year 1

$_iRP_{1_1}$ is the regional product in primary activities in the year 1

$_iRP_{2_1}$ is the regional product in secondary activities in the year 1

$_iRP_{3_1}$ is the regional product in tertiary activities in the year 1.

6. INCOME POTENTIAL AND SPATIAL INTERACTION

Thus far the formulations assume that each region represents a closed self-sufficient economy having no relationships with other regions. This in reality, however, is hardly the case. Thus the concept of "income potential" is introduced whereby the spatial nature of relationships between regions is taken into account.

The basic concept stems from the so-called "Law of Demographic Gravitation" where the interaction between two population centers is directly proportional to the product of the two populations and inversely proportional to the distance between them. This "law" has been applied to income and money flows in determining market analysis and other economic examinations.

The force of interaction in demographic gravitation is analogous to the force of interaction between two masses in a physical system. Similarly, the physical concept of potential energy has a parallel in a demographic or economic context, namely the concept of potential for population or income interaction. This concept measures the influence of people or dollars at a distance. Thus the potential of income produced by a region "j" on another region "i" is given by:

$$_iV_j = \frac{G \cdot Y_j}{d_{ij}}$$

where $_iV_j$ is the potential of income produced by region "j" on region "i"
Y_j is the income of region "j"
d_{ij} is the economic distance between region "i" and "j"
and G is the so-called "gravitational" constant

In an economy with a number of regions, the potential of income produced by all of those regional incomes on a given region "i" is given by:

$$_iV = \frac{GY_1}{d_{i-1}} + \frac{GY_2}{d_{i-2}} + \ldots\ldots\ldots\ldots + \frac{GY_n}{d_{in}}$$

or:

$$_iV = \sum_{j=1}^{j=n} \frac{G}{d_{ij}} \cdot Y_j$$

When for any region V is low, this indicates a region which is far from markets so that the region tends to enjoy few interregional relationships because of high transport costs. Conversely when V is high one would expect a region close to markets enjoying considerable interregional transactions.

To reflect differential rates of change of income between regions, the income potential for one year is compared with that for a later year. The relationship between them is expressed as the "relative income potential" over time between a region and all other regions in the economy and is represented thus:

$$_iVP = \frac{_iV_2}{_iV_1}$$

where $_iVP$ is the relative income potential for region "i"
$_1V_2$ is the income potential for region "i" in the year 2
$_1V_1$ is the income potential for region "i" in the year 1

If all regions grew in total income by the same amount this expression would then equal "1". However, since this in effect would have no influence on interregional relations, a more desirable measure would be one equalling zero for this situation. Thus "1" is subtracted from this expression to indicate that when no regional variation in relative income potential exists between regions, the concept has no effect on the basic product determinations.

Also unaccounted for in the basic determination are differences in natural resources, capital investment, depreciation, and other similar factors which make up the total product accounts. An example of the workings of such factors is found in the State of Washington where, by virtue of resource structure, that state has closer relationships with the Eastern seaboard than its income potential alone would indicate. Thus in effect these factors modify the distance factor in interregional relationships. In determining total product, these factors are combined into one coefficient "L" which is multiplied by the relative income potential to determine the net effect of distance between regions.

Thus, while total product in a projected year is considered a function of labor force, productivity and the changes inherent in these variables, it is also considered a function of the effects of resources and distances to markets in relation to previous levels of productivity and the basic formula for regional product becomes:

$$ {}_iGRP_1 = {}_iL_0 \ (1 + {}_ip)(1 + {}_iz)\,{}_iT_0 + {}_iB \ ({}_iVP - 1)\,{}_iGRP_0 $$

Further subdivided according to classification of activity the formula becomes:

$$ {}_iGRP_1 = {}_iL_{i_0} \ (1 + {}_ip)(1 + {}_ir_1)(1 + {}_iz_1)\,{}_iT_{1_0} + {}_iB_1 \ ({}_iVP_1 - 1)\,{}_iRP_{1_0} $$
$$ + {}_iL_{2_0} \ (1 + {}_ip)(1 + {}_ir_2)(1 + {}_iz_2)\,{}_iT_{2_0} + {}_iB_2 \ ({}_iVP_2 - 1)\,{}_iRP_{2_0} $$
$$ + {}_iL_{3_0} \ (1 + {}_ip)(1 + {}_ir_3)(1 + {}_iz_3)\,{}_iT_{3_0} + {}_iB_3 \ ({}_iVP_3 - 1)\,{}_iRP_{3_0} $$

7. AN ILLUSTRATIVE MODEL

By way of illustrating the operational mechanics of this formulation, a hypothetical three region nation was conceived and projections for it carried out on the basis of assumed initial data. Thus the example indicates the methodology and calculations necessary to carry out the analysis and illustrates the kind of results obtained for planning purposes.

On page 7 and 8 following is found the basic data which was utilized in constructing the hypothetical model. On these data sheets it can be seen that three regions were set up, each differing markedly in basic characteristics.

Region I - This region was set up to represent what might be comparable to New England in that it is intended to be a mature, well developed economy with a ratio of 1:3:5 in the distribution of primary, secondary and tertiary activities respectively in the first year. Subsequently, as the data indicates primary activities suffer a considerable decline in employment but with a proportionate increase in productivity. Manufacturing activities enjoyed a moderate increase but, as is characteristic of older economies, there occurred a slight decrease in productivity due to obsolescence and agglomeration inefficiencies. Healthy growth in tertiary activities is indicated with roughly a constant productivity and a rising level of income.

Region II - As hypothesized, this region might be comparable to the Southeastern part of the United States. In the initial year it is largely concerned with primary activities, and even though employment declines in this area, in the second year primary employment still accounts for almost a third of all gainfully employed workers. Productivity in primary activities is increasing but incomes are declining. Secondary activities or manufacturing in this region enjoys considerable growth, showing the greatest employment gains both in absolute terms and in relative terms. Productivity shows a healthy increase as do incomes. As the region is evidently going through an industrialization period, tertiary activities, though important, do not share similar gains.

Region III - This region is intended to be the "New York" region for the purposes of this model with one important exception. As indicated by the economic distances between regions, Region III is somewhat more removed from the other two regions geographically. However, it is a large vigorous urban

complex, relatively self-sufficient and enjoying considerable growth in population and interregional economic activity. The tertiary sector of the economy is most dynamic, showing considerable increases generated in terms of employment, value of product and income. Growth in the manufacturing sector lags only slightly behind in terms of growth and it is only in primary activities where any evidence of decline appears. It is the population center of the hypothetical nation, being almost twice as large as the other two regions.

8. CALCULATIONS FOR PROJECTING THE HYPOTHETICAL MODEL

Calculation I (pages 10, 11, 12, 13) Income Potentials

These four pages illustrate the calculations necessary for determining income potential. These calculations are carried out for each activity in each region. It should be noted that by virtue of the formulation of income potential in the basic equation the so-called gravitational constant cancels out and accordingly does not have to be evaluated.

Calculation II (pages 14 and 15) "B" Coefficients

Once income potential is determined for each activity in each region, these results can be combined with the initial data for purposes of calculating the "B" coefficients. These coefficients serve to indicate the net effects of differences in resources structure between regions with respect to each particular activity.

Calculation III (page 16) Gross National Product Projections

Once income potentials and "B" coefficients are determined, the basic equations are ready for use for projection purposes. Before this, however, an independent projection of gross national product is made -- in this case by a simple extrapolation of the trend established by year 1 and year 2. In applying this in a real situation the projections of gross national product developed by the U. S. Dept. of Commerce would be used.

An independent projection is made primarily as a check on the assumptions as to how certain variables will act within each regional economy in utilizing the regional equations. These variables include rate of population growth, rate of shift in distribution of employment among the three basic activities, rate of increase in productivity, rate of change in income potential, and rate of change (if any) in the "B" coefficients.

Thus the independent projection of GNP is used as a starting point and the variables in the regional equations can be manipulated until a thoroughly consistent distribution of the national economy throughout the regions is determined.

Calculation IV (Pages 16, 17, 18) PROJECTIONS OF REGIONAL PRODUCT

As indicated on the noted pages, after all data and values of the basic regional equations are determined for projecting purposes, a series of trial solutions is computed and compared with the independent GNP projection of Calculation III. This is carried on as indicated until a reasonable "fit" of all parts of the economy is achieved.

Calculation V (Page 16) Labor Force Projections

Once a fit is achieved, those variables which affect labor force are extracted from the total equation and calculated to determine the projected labor force. These variables include: L, p, and r.

Calculation VI (pages 19, 20, 21) Income Projections

From the basic values of income potential, future income levels can be calculated. For each activity a set of simultaneous equations can be set up and solved for future income in each activity distributed in each region.

SUMMARY OF PROJECTIONS (page 22 (Fold Out) and 23)

The last two pages compile a summary and a brief interpretation of projections with consideration of methodology in relation to utilizing this technique to project future levels of the Boston economy.

ILLUSTRATIVE EXAMPLE FOR HISTORICAL ANALYSIS — DATA SHEET #1

HYPOTHETICAL BASIC DATA

ASSUME A 3-REGION NATIONAL MODEL WITH DATA FOR TWO DIFFERENT YEARS

			Primary	Secondary	Tertiary	Total
REGION I	Year 1	Employment	1,000	3,000	5,000	9,000
		Product ( )	4 million	15 million	28 million	47 million
		Income ($)	2 million	9 million	25 million	36 million
	Year 2	Employment	500	4,000	8,000	12,500
		Product ( )	4 million	18 million	42 million	64 million
		Income ( )	1 million	14 million	37 million	52 million
REGION II	Year 1	Employment	5,000	3,000	4,000	12,000
		Product ( )	13 million	13 million	21 million	47 million
		Income ( )	8 million	10 million	16 million	34 million
	Year 2	Employment	4,000	5,000	5,000	14,000
		Product ( )	16 million	23 million	24 million	63 million
		Income ( )	7 million	18 million	20 million	45 million
REGION III	Year 1	Employment	2,000	4,000	6,000	12,000
		Product ( )	7 million	24 million	48 million	79 million
		Income ( )	5 million	16 million	33 million	54 million
	Year 2	Employment	2,000	8,000	15,000	25,000
		Product ( )	8 million	52 million	130 million	190 million
		Income ( )	4 million	36 million	90 million	130 million
NATION	Year 1	Employment	8,000	10,000	15,000	33,000
		Product ( )	24 million	52 million	97 million	173 million
		Income ( )	15 million	35 million	74 million	124 million
	Year 2	Employment	6,500	17,000	28,000	45,000
		Product ( )	28 million	93 million	196 million	317 million
		Income ( )	12 million	68 million	147 million	227 million

ECONOMIC DISTANCES BETWEEN REGIONS ** REGION I-REGION 2 ---- 50
REGION I-REGION 3 ---- 150
REGION 2-REGION 3 ---- 100

USTRATIVE EXAMPLE FOR HISTORICAL ANALYSIS — DATA SHEET #2

ULATION DATA

		POPULATION	RATE OF CHANGE
ION I --	Year 1	30,000	
	Year 2	40,000	p = 0.33
ION II --	Year 1	40,000	
	Year 2	45,000	p = 0.125
ION III --	Year 1	40,000	
	Year 2	80,000	p = 1.000
ION --	Year 1	110,000	
	Year 2	165,000	p = 0.500

ES OF SHIFT OF ACTIVITIES BETWEEN YEAR 1 AND YEAR 2 (r)

ION I -- Rate of shift to or from activities

$_1r_1$ = - 0.07 (primary)

$_1r_2$ = - 0.01 (secondary)

$_1r_3$ = + 0.08 (tertiary)

ION II -- Rate of shift to or from activities

$_2r_1$ = - 0.14 (primary)

$_2r_2$ = + 0.11 (secondary)

$_2r_3$ = + 0.03 (tertiary)

ION III -- Rate of Shift to or from activities

$_3r_1$ = - 0.10 (primary)

$_3r_2$ = + 0.04 (secondary)

$_3r_3$ = + 0.06 (tertiary)

DUCTIVITY

ION I

ary Year 1 - 4,000	Primary Year 1 2,600	Primary Year 1 3,500
Year 2 - 8,000	Year 2 4,000	Year 2 4,000
ge Rate (z)+ 1.00	Change Rate (z) + 0.54	Change Rate (z) + 0.14
ndary Yr 1 5,000	Secondary Yr 1 4,330	Secondary Yr 1 6,000
Year 2 4,500	Year 2 4,600	Year 2 6,500
ge Rate (z) - 0.10	Change Rate (z) + 0.06	Change Rate (z) + 0.08
iary Yr 1 5,600	Tertiary Yr 1 5,250	Tertiary Yr 1 6,500
Year 2 5,250	Year 2 4,800	Year 2 7,000
ge Rate (z) - 0.06	Change Rate (z) - 0.09	Change Rate (z) + 0.08

ALCULATION I

NCOME POTENTIALS

asic Formulation:

$$ {}_1V = G \cdot {}_jY / d_{ij} \quad \text{or} \quad {}_1V = G\frac{{}_1Y}{d_{1-1}} + G\frac{{}_2Y}{d_{2-i}} + G\frac{{}_3Y}{d_{3-i}} $$

here:

${}_1V$ is the income potential of region "1" for any given year

G is the "gravitational" constant

${}_1Y$, ${}_2Y$, and ${}_3Y$ are the incomes, respectively, for regions 1, 2 and 3

hese variables can be further refined by consideration of activity and time

hus: ${}_1V_{1_1}$ is the income potential for region 1's primary activity in year 1

${}_1V_{1_2}$ is the income potential for region 1's primary activity in year 2

${}_1V_{2_1}$ is the income potential for region 1's secondary activity in year 1

${}_1V_{2_2}$ is the income potential for region 1's secondary activity in year 2

${}_1V_{3_1}$ is the income potential for region 1's tertiary activity in year 1

${}_1V_{3_2}$ is the income potential for region 1's tertiary activity in year 2

${}_2V_{1_1}$ is the income potential for region 2's primary activity in year 1

and so on . . .

lso:

${}_1Y_{1_1}$ is the income of region 1 from primary activity in year 1

${}_2Y_{3_2}$ is the income of region 2 from tertiary activity in year 2

and so on . . .

"RELATIVE INCOME POTENTIAL" refers to the change in income potential between regions over time. Thus the income potential for year 2 divided by the income potential for year 1 will provide a measure of this change.

$\frac{{}_2V_{3_2}}{{}_2V_{3_1}}$ thus is the expression for this change. However, if all regions

changed by the same amount over time, income potential would have no effect on any region's productivity. In this instance, relative income potential should equal zero. This expression should then have one subtracted from it, and the final expression for relative income potential becomes:

$$ \frac{{}_2V_{3_2}}{{}_2V_{3_1}} - 1 $$

CALCULATION I (Continued)

INCOME POTENTIALS

REGION I - PRIMARY ACTIVITY

$$I^{V}_{1_1} = \frac{G \times 2{,}000{,}000}{1} + \frac{G \times 8{,}000{,}000}{50} + \frac{G \times 5{,}000{,}000}{150} = 2{,}173{,}000\ G$$

$$I^{V}_{1_2} = \frac{1{,}000{,}000\ G}{1} + \frac{7{,}000{,}000\ G}{50} + \frac{4{,}000{,}000\ G}{150} = 1{,}667{,}000\ G$$

$$\frac{I^{V}_{1_2}}{I^{V}_{1_1}} = 0.77$$

REGION I - SECONDARY ACTIVITY

$$I^{V}_{2_1} = \frac{9{,}000{,}000\ G}{1} + \frac{10{,}000{,}000\ G}{50} + \frac{16{,}000{,}000\ G}{150} = 9{,}307{,}000\ G$$

$$I^{V}_{2_2} = \frac{14{,}000{,}000\ G}{1} + \frac{18{,}000{,}000\ G}{50} + \frac{36{,}000{,}000\ G}{150} = 14{,}600{,}000\ G$$

$$\frac{I^{V}_{2_2}}{I^{V}_{2_1}} = 1.57$$

REGION I - TERTIARY ACTIVITY

$$I^{V}_{3_1} = \frac{25{,}000{,}000\ G}{1} + \frac{16{,}000{,}000\ G}{50} + \frac{33{,}000{,}000\ G}{150} = 25{,}550{,}000\ G$$

$$I^{V}_{3_2} = \frac{37{,}000{,}000\ G}{1} + \frac{20{,}000{,}000\ G}{50} + \frac{90{,}000{,}000\ G}{150} = 38{,}000{,}000\ G$$

$$\frac{I^{V}_{3_2}}{I^{V}_{3_1}} = 1.49$$

CALCULATION 1 (Continued)

INCOME POTENTIALS

REGION II - PRIMARY ACTIVITY

$$ {}_2V_{1_1} = \frac{8{,}000{,}000\ G}{1} + \frac{2{,}000{,}000\ G}{50} + \frac{5{,}000{,}000\ G}{100} = 8{,}090{,}000\ G $$

$$ {}_2V_{1_2} = \frac{7{,}000{,}000\ G}{1} + \frac{1{,}000{,}000\ G}{50} + \frac{4{,}000{,}000\ G}{100} = 7{,}060{,}000\ G $$

$$ \frac{{}_2V_{1_2}}{{}_2V_{1_1}} = 0.87 $$

REGION II - SECONDARY ACTIVITY

$$ {}_2V_{2_1} = \frac{10{,}000{,}000\ G}{1} + \frac{9{,}000{,}000\ G}{50} + \frac{16{,}000{,}000\ G}{100} = 10{,}340{,}000\ G $$

$$ {}_2V_{2_2} = \frac{18{,}000{,}000\ G}{1} \quad \frac{14{,}000{,}000\ G}{50} \quad \frac{36{,}000{,}000\ G}{100} = 18{,}640{,}000\ G $$

$$ \frac{{}_2V_{2_2}}{{}_2V_{2_1}} = 1.80 $$

REGION II - TERTIARY ACTIVITY

$$ {}_2V_{3_1} = \frac{16{,}000{,}000\ G}{1} + \frac{25{,}000{,}000\ G}{50} + \frac{33{,}000{,}000\ G}{100} = 16{,}830{,}000\ G $$

$$ {}_2V_{3_2} = \frac{20{,}000{,}000\ G}{1} + \frac{37{,}000{,}000\ G}{50} + \frac{90{,}000{,}000\ G}{100} = 21{,}640{,}000\ G $$

$$ \frac{{}_2V_{3_2}}{{}_2V_{3_1}} = 1.29 $$

CALCULATION I (Continued)

INCOME POTENTIALS

REGION III - PRIMARY ACTIVITY

$$ {}^{3}V_{1_1} = \frac{5,000,000\ G}{1} + \frac{8,000,000\ G}{100} + \frac{2,000,000\ G}{150} = 5,093,000\ G $$

$$ {}^{3}V_{1_2} = \frac{4,000,000\ G}{1} + \frac{7,000,000\ G}{100} + \frac{1,000,000\ G}{150} = 4,077,000\ G $$

$$ \frac{{}^{3}V_{1_2}}{{}^{3}V_{1_1}} = 0.80 $$

REGION III - SECONDARY ACTIVITY

$$ {}^{3}V_{2_1} = \frac{16,000,000\ G}{1} + \frac{10,000,000\ G}{100} + \frac{9,000,000\ G}{150} = 16,160,000\ G $$

$$ {}^{3}V_{2_2} = \frac{36,000,000\ G}{1} + \frac{18,000,000\ G}{100} + \frac{14,000,000\ G}{150} = 36,111,000\ G $$

$$ \frac{{}^{3}V_{2_2}}{{}^{3}V_{2_1}} = 2.24 $$

REGION III - TERTIARY ACTIVITY

$$ {}^{3}V_{3_1} = \frac{33,000,000\ G}{1} + \frac{16,000,000\ G}{100} + \frac{25,000,000\ G}{150} = 33,326,000\ G $$

$$ {}^{3}V_{3_2} = \frac{90,000,000\ G}{1} + \frac{20,000,000\ G}{100} + \frac{37,000,000\ G}{150} = 90,450,000\ G $$

$$ \frac{{}^{3}V_{3_2}}{{}^{3}V_{3_1}} = 2.72 $$

CALCULATION II

"B" COEFFICIENTS

ILLUSTRATION OF FORMULATION

$_1RP_{1_2}$ = Region I regional product in primary activities in year 2

$_1L_{1_1}$ = Region I labor force in primary activities in year 1

$_1p$ = Rate of Population Growth of Region I

$_1r_1$ = Region I rate of shift into or out of primary activities

$_1z_1$ = Region I rate of change of Productivity in primary activities

$_1T_{1_1}$ = Region I Average Productivity in primary activities in year 1

$_1VP_1 = \frac{_1V_{1_2}}{_1V_{1_1}}$ = Region I relative Income Potential in primary activities

$_1B_1$ = "B" Coefficient for primary activities in Region I

$$_1RP_{1_2} = {}_1L_{1_1}(1 + {}_1p)(1 + {}_1r_1)(1 + {}_1z_1){}_1T_{1_1} + {}_1B_1({}_1VP_1 - 1){}_1RP_{1_1}$$

REGION I - "B" for Primary Activities

$4{,}000{,}000 = 1000\ (1 + 0.33)(1 - 0.07)(1 + 1.00)(4000) + B\ \ (0.77 - 1)4{,}000{,}000$

$_1B_1 = 6.408$

REGION I - "B" for Secondary Activities

$18{,}000{,}000 = 3000(1 + 0.33)(1 - 0.01)(1 - 0.10)(5000) + {}_1B_2\ (1.57 - 1)15{,}000{,}000$

$_1B_2 = 0.026$

REGION I - "B" for Tertiary Activities

$42{,}000{,}000 = 5000(1 + 0.33)(1 + 0.08)(1 - 0.06)(5600) + {}_1B_3\ (1.49 - 1)28{,}000{,}000$

$_1B_3 = 0.306$

SUMMARY: $_1B_1 = 6.408$
$_1B_2 = 0.026$
$_1B_3 = 0.306$

LCULATION II

" COEFFICIENTS

EGION II - "B" for Primary Activities

$5,000,000 = 5000\ (1 + 0.125)(1 - 0.14)(1 + 0.54)(2600) + {}_2B_1(0.87 - 1)13,000,000$

$B_1 = 1.994$

EGION II - "B" for Secondary Activities

$3,000,000 = 3000\ (1 + 0.125)(1 + 0.11)(1 + 0.06)1330 + {}_2B_2(1.80 - 1)13,000,000$

$B_2 = 0.558$

EGION II - "B" for Tertiary Activities

$1,000,000 = 4000\ (1 + 0.125)(1 + 0.03)(1 - 0.90)3500 + {}_2B_3\ (1.29 - 1)21,000,000$

$B_3 = 1.517$

EGION III - "B" for Primary Activities

$,000,000 = 2,000(1 + 1.00)(1 - 0.10)(1 + 0.14)3500 + {}_3B_1\ (0.80 - 1)\ 7,000,000$

$B_1 = 4.546$

econdary Activities

$2,000,000 = 8000(1 + 1.00)(1 + 0.04)(1 + 0.08)6000 + {}_3B_2\ (?.24 - 1)24,000,000$

$B_2 = - 0.064$

ertiary Activities

$30,000,000 = 6000\ (1 + 1.00)(1 + 0.06)(1 + 0.08)6500 + {}_3B_3\ (2.72 - 1)48,000,000$

$B_3 = 0.493$

UMMARY OF "B" COEFFICIENTS

$B_1 = 6.408$	${}_2B_1 = 1.994$	${}_3B_1 = 4.546$
$B_2 = 0.026$	${}_2B_2 = 0.558$	${}_3B_2 = - 0.064$
$B_3 = 0.306$	${}_2B_3 = 1.517$	${}_3B_3 = 0.493$

CALCULATION III - PROJECTION OF GROSS NATIONAL PRODUCT

Gross National Product can be projected a number of ways, and in the national economy, such projections are already available from the U. S. Department of Commerce.

For this illustrative example, GNP for projected year "X" is simply an extrapolated percentage rate of increase:

Thus: GNP in year 1 = 173 million
GNP in year 2 = 317 million

and: GNP projected to year "X" = 580 million

CALCULATION IV - PROJECTION OF REGIONAL PRODUCT

Regional Products are calculated on the basis of a series of trial solutions. The first solution assumes all rates of change in the basic formulation remain constant and regional products are calculated and summed. If the final summation does not equal the projected gross national product, additional regional product solutions are calculated after relaxing one or more of the original assumptions. How these assumptions are changed can be determined by going back over the historical data and noting how rates of change have varied in the past. In the illustration below, with all rates of change assumed constant, the sum of the projected regional products came out 13% too high in comparison with the extrapolated GNP. Relaxing one assumption -- that of population growth in Region III -- brought the sum of the individual regional product projections to 582 million or within $\frac{1}{2}$% of the original GNP projection of 580 million. Thus if this solution is accepted, population growth in Region III is seen to be only 60% between year 2 and year "X" rather than the 100% between year 1 and year 2. (The absolute increase in population turns out to be virtually the same for both periods, however). For the purposes of this illustration, this was accepted as sufficient adjustment of change rates to provide a satisfactory solution. Thus with the one exception of population growth in Region III, all interregional relationships in the projection remained the same. In dealing with the Boston economy in the United States, considerably more examination of historical rates of change of productivity, income potential, shifts in labor force distribution, etc. will be required, but the illustration serves to point up the operations required.

ALCULATION IV (Continued)

ROJECTION OF REGIONAL PRODUCT

IRST TRIAL SOLUTION

ssumptions: 1. Assume constant rate of population growth (p)
2. Assume constant rate of change in labor force distribution (r)
or All 3. Assume constant rate of change in productivity (z)
egions 4. Assume constant relative income potential V_2/V_1
5. Assume constant "B" Coefficients

EGION I

GRP_x = 500(1 + 0.33)(1 - 0.07)(1 + 1.00)8000 + 6.408 (0.77 - 1)4,000,000
+ 4000(1 + 0.33)(1 - 0.01)(1 - 0.10)4500 + 0.026 (1.57 - 1)18,000,000
+ 8000(1 + 0.33)(1 + 0.08)(1 - 0.06)5250 + 0.306 (1.49 - 1)42,000,000

GRP_x = 88,579,220

EGION II

GRP_x = 4000(1 + 0.125)(1 - 0.14)(1 + 0.54)4000 + 1.994 (0.87 - 1)16,000,000
+ 5000(1 + 0.125)(1 + 0.11)(1 + 0.06)4600 + 0.558 (1.80 - 1)23,000,000
+ 5000(1 + 0.125)(1 + 0.03)(1 - 0.90)4800 + 1.517 (1.29 - 1)24,000,000

GRP_x = 96,268,825

EGION III

GRP_x = 2000(1 + 1.00)(1 - 0.10)(1 + 0.14)4000 + 4.546 (0.80 - 1)8,000,000
+ 8000(1 + 1.00)(1 + 0.04)(1 + 0.08)6500 + (-0.064)(2.28 - 1) 52,000,000
+ 15000(1 + 1.00)(1 + 0.06)(1 + 0.08)7000 + (0.493)(2.72 - 1) 130,000,000

GRP_x = 472,471,280

ROSS NATIONAL PRODUCT

$NP_x = {}_1GRP_x + {}_2GRP_x + {}_3GRP_x$ = 88,579,220 + 96,268,825 + 472,471,280

NP_x = 657,319,325 (13% higher than initial GNP Projection of 580,000,000)

ALCULATION IV - (Continued)

ROJECTION OF REGIONAL PRODUCT

ECOND TRIAL SOLUTION

ssumptions:
1. Assume constant rate of population growth (p) for Regions I & II
2. Assume rate of population growth declines in Region III from 1.0 to 0.6
3. Assume constant rate of change in labor force Distribution (r) in all regions
4. Assume constant rate of change in productivity (z) for all regions
5. Assume constant relative income potential for all regions
6. Assume constant "B" Coefficients

EGION I - NO CHANGE

GRP_x = 88,579,220

EGION II - NO CHANGE

GRP_x = 96,268,825

EGION III

$$GRP_x = 2000(1 + 0.60)(1 - 0.10)(1 + 0.14)4000 + 4.546\ (0.80 - 1)\ 8,000,000$$
$$+ 8000(1 + 0.60)(1 + 0.04)(1 + 0.08)6500 + (-0.064)(2.24 - 1)52,000,000$$
$$+ 15000(1 + 0.60)(1 + 0.06)(1 + 0.08)7000 + (0.493)\ (2.72 - 1)130,000,000$$

GRP_x = 397,743,400

GNP_x = 582,591,445 ($\frac{1}{2}$% higher than initial GNP projection of 580,000,000)

ALCULATION V

ABOR FORCE PROJECTIONS

EGION I	REGION II	REGION III
rimary = 500(1.33)(0.93)	Primary = 4000(1.125)(0.86)	Primary = 2000(1.6)(0.90)
econd. = 4000(1.33)(0.99)	Secondary = 5000(1.125)(1.11)	Second. = 8000(1.6)(1.04)
ert. = 8000(1.33)(1.08)	Tert. = 5000(1.125)(1.03)	Tert. = 15000(1.6)(1.06)
rimary = 618	Primary = 3,870	Primary = 2,880
econdary= 5,267	Secondary = 6,244	Second. = 13,312
ertiary =11,491	Tertiary = 5,794	Tertiary = 25,440
OTAL = 17,376	TOTAL = 15,908	TOTAL = 41,632

OTAL NATIONAL LABOR FORCE = 74,916

CALCULATION VI

INCOME PROJECTIONS

PRIMARY ACTIVITIES

$$\frac{{}^{V}l_x}{{}^{V}l_2} = 0.77 = \frac{\frac{{}^{1Y}l_x{}^{G}}{1} + \frac{{}^{2Y}l_x{}^{G}}{50} + \frac{{}^{3Y}l_x{}^{G}}{150}}{{}^{1V}l_2} \qquad (1)$$

$$\frac{{}^{V}l_x}{{}^{V}l_2} = 0.87 = \frac{\frac{{}^{2Y}l_x{}^{G}}{1} + \frac{{}^{2Y}l_x{}^{G}}{50} + \frac{{}^{3Y}l_x{}^{G}}{100}}{{}^{2V}l_2} \qquad (2)$$

$$\frac{{}^{V}l_x}{{}^{V}l_2} = 0.80 = \frac{\frac{{}^{3Y}l_x{}^{G}}{1} + \frac{{}^{2Y}l_x{}^{G}}{100} + \frac{{}^{1Y}l_x{}^{G}}{150}}{} \qquad (3)$$

$${}_{1}{}^{Y}l_x + (0.02)\,{}_{2}{}^{Y}l_x + (0.007)\,{}_{3}{}^{Y}l_x = 0.77\ (1,667,000) \qquad (1)$$

$$(0.02)\,{}_{1}{}^{Y}l_x + {}_{2}{}^{Y}l_x + (0.01)\,{}_{3}{}^{Y}l_x = 0.87\ (7,060,000) \qquad (2)$$

$$(0.007)\,{}_{1}{}^{Y}l_x + (0.01)\,{}_{2}{}^{Y}l_x + {}_{3}{}^{Y}l_x = 0.80\ (4,077,000) \qquad (3)$$

Solving these simultaneous equations yields:

FOR YEAR "X"

REGION I - Primary Income = 1,100,750

REGION II - Primary Income = 6,095,265

REGION III - Primary Income = 3,192,065

CALCULATION VI (continued)

INCOME PROJECTIONS

SECONDARY ACTIVITIES

$$\frac{{}_1V_{2_x}}{{}_1V_{2_2}} = 1.57 = \frac{\frac{{}_1Y_{2_x}G}{1} + \frac{{}_2Y_{2_x}G}{50} + \frac{{}_3Y_{2_x}G}{150}}{{}_1V_{2_2}} \qquad (1)$$

$$\frac{{}_2V_{2_x}}{{}_2V_{2_2}} = 1.80 = \frac{\frac{{}_2Y_{2_x}G}{1} + \frac{{}_1Y_{2_x}G}{50} + \frac{{}_3Y_{2_x}G}{100}}{{}_2V_{2_2}} \qquad (2)$$

$$\frac{{}_3V_{2_x}}{{}_3V_{2_2}} = 2.24 = \frac{\frac{{}_3Y_{2_x}G}{1} + \frac{{}_2Y_{2_x}G}{100} + \frac{{}_1Y_{2_x}G}{150}}{{}_3V_{2_2}} \qquad (3)$$

$${}_1Y_{2_x} + (0.02){}_2Y_{2_x} + (0.007){}_3Y_{2_x} = 1.57 \quad (14,600,000) \qquad (1)$$

$$(0.02){}_1Y_{2_x} + {}_2Y_{2_x} + (0.01){}_3Y_{3_x} = 1.80 \quad (18,640,000) \qquad (2)$$

$$(0.007){}_1Y_{2_x} + (0.01){}_2Y_{2_x} + {}_3Y_{3_x} = 2.24 \quad (36,111,000) \qquad (3)$$

Solving these simultaneous equations yields:

FOR YEAR "X"

REGION I - Secondary Income = $21,712,833

REGION II - Secondary Income = $32,313,607

REGION III - Secondary Income = $80,413,587

CALCULATION VI (continued)

INCOME PROJECTIONS

TERTIARY ACTIVITIES

$$\frac{{}_1V_{3_x}}{{}_1V_{3_2}} = 1.49 = \frac{\frac{{}_1Y_{3_x}{}^G}{1} + \frac{{}_2Y_{3_x}{}^G}{50} + \frac{{}_3Y_{3_x}{}^G}{150}}{{}_1V_{3_2}} \qquad (1)$$

$$\frac{{}_2V_{3_x}}{{}_2V_{3_2}} = 1.29 = \frac{\frac{{}_2Y_{3_x}{}^G}{1} + \frac{{}_1Y_{3_x}{}^G}{50} + \frac{{}_3Y_{3_x}{}^G}{100}}{{}_2V_{3_2}} \qquad (2)$$

$$\frac{{}_3V_{3_x}}{{}_3V_{3_2}} = 2.72 = \frac{\frac{{}_3Y_{3_x}{}^G}{1} + \frac{{}_2Y_{3_x}{}^G}{100} + \frac{{}_1Y_{3_x}{}^G}{150}}{{}_3V_{3_2}} \qquad (3)$$

$${}_1Y_{3_x} + (0.02)\,{}_2Y_{3_x} + (0.007)\,{}_3Y_{3_x} = 1.49\ (38{,}000{,}000) \qquad (1)$$

$$(0.02)\,{}_1Y_{3_x} + {}_2Y_{3_x} + (0.02)\,{}_3Y_{3_x} = 1.29\ (21{,}640{,}000) \qquad (2)$$

$$(0.007)\,{}_1Y_{3_x} + (0.01)\,{}_2Y_{3_x} + {}_3Y_{3_x} = 2.72\ (90{,}450{,}000) \qquad (3)$$

Solving these simultaneous equations yields:

FOR YEAR "X" : REGION I - Tertiary Income = 54,414,737

REGION II - Tertiary Income = 24,381,178

REGION III- Tertiary Income = 245,399,285

SUMMARY - INCOME PROJECTIONS FOR YEAR "X"

REGION I		REGION II		REGION III	
Primary Income =	1,140,750	Primary Income =	6,095,265	Primary Income =	3,192,065
Secondary	21,712,833	Secondary	32,313,607	Secondary	80,413,587
Tertiary	54,414,737	Tertiary	24,381,178	Tertiary	245,399,285
TOTAL	77,268,320	TOTAL	62,790,050	TOTAL	329,004,937

TOTAL NATIONAL INCOME -- 469,063,307

ROJECTIONS

EGION I

	Year 1	Year 2	Projected Year "X"
EMPLOYMENT			
Primary Employment	1,000	500	620
Secondary Employment	3,000	4,000	5,270
Tertiary Employment	5,000	8,000	11,490
TOTAL EMPLOYMENT	9,000	12,500	17,380
GROSS REGIONAL PRODUCT			
Primary Product	4,000,000	4,000,000	3,999,850
Secondary Prouct	15,000,000	18,000,000	21,597,300
Tertiary Product	28,000,000	42,000,000	62,982,080
TOTAL GROSS REG. PRODUCT	$47,000,000	$64,000,000	$88,579,230
INCOME			
Primary Income	$ 2,000,000	1,000,000	1,140,750
Secondary Income	9,000,000	14,000,000	21,712,830
Tertiary Income	25,000,000	37,000,000	54,414,740
TOTAL INCOME	$36,000,000	$52,000,000	$77,268,320
POPULATION	30,000	40,000	53,300
% OF POPULATION IN LABOR FORCE	33%	32%	31%
INCOME PER EMPLOYEE			
Primary Inc./Emp.	$2,000	$2,000	$1,850
Secondary Inc./Emp.	3,000	3,500	4,120
Tertiary Inc./Emp.	5,000	4,630	4,740
AVERAGE INCOME PER EMPLOYEE	$4,000	$4,160	$4,440
PER CAPITA INCOME	$1,200	$1,300	$1,450
PRODUCTIVITY			
Primary Productivity/Emp.	$4,000	$8,000	$6,450
Second. Productivity/Emp.	5,000	4,500	4,100
Tertiary Productivity/Emp.	5,600	5,250	5,480
AVERAGE PRODUCTIVITY PER EMPLOYEE	$5,230	$5,120	5,110

ROJECTIONS

EGION II

	Year 1	Year 2	Projected Year "X"
. EMPLOYMENT			
Primary Employment	5,000	4,000	3,870
Secondary Employment	3,000	5,000	6,240
Tertiary Employment	4,000	5,000	5,790
TOTAL EMPLOYMENT	12,000	14,000	15,900
. GROSS REGIONAL PRODUCT			
Primary Product	$13,000,000	$16,000,000	$19,691,680
Secondary Product	13,000,000	23,000,000	40,711,725
Tertiary Product	21,000,000	24,000,000	35,865,420
GROSS REG. PRODUCT	$47,000,000	$63,000,000	$96,268,825
. INCOME			
Primary Income	8,000,000	$7,000,000	$6,095,265
Secondary Income	10,000,000	18,000,000	32,313,607
Tertiary Income	16,000,000	20,000,000	24,381,178
TOTAL INCOME	$34,000,000	$45,000,000	$62,790,050
. POPULATION	40,000	45,000	50,600
. % OF POPULATION IN LABOR FORCE	33%	32%	32%
. INCOME PER EMPLOYEE			
Primary Inc./Emp.	$1,600	$1,750	$1,575
Secondary Inc./Emp.	3,330	3,600	5,180
Tertiary Inc./Emp.	4,000	4,000	4,210
AV. INCOME PER EMPLOYEE	$2,840	3,210	3,940
. PER CAPITA INCOME	$ 850	$1,000	$1,240
. PRODUCTIVITY			
Primary Productivity/Emp.	$2,600	$4,000	$5,100
Secondary Productivity/Emp.	4,330	4,600	6,510
Tertiary Productivity/Emp.	5,250	4,800	6,200
AVERAGE PRODUCTIVITY PER EMPLOYEE	$3,920	$4,500	$6,050

PROJECTIONS

REGION III

	Year 1	Year 2	Projected Year "X"
1. EMPLOYMENT			
Primary Employment	2,000	2,000	2,880
Secondary Employment	4,000	8,000	13,312
Tertiary Employment	6,000	15,000	25,440
TOTAL EMPLOYMENT	12,000	25,000	41,632
2. GROSS REGIONAL PRODUCT			
Primary Product	$ 7,000,000	$ 8,000,000	$ 5,858,680
Secondary Product	24,000,000	52,000,000	89,323,520
Tertiary Product	48,000,000	130,000,000	302,561,200
GROSS REGIONAL PRODUCT	$79,000,000	$190,000,000	$397,743,400
3. INCOME			
Primary Income	$ 5,000,000	$ 4,000,000	$ 3,192,065
Secondary Income	16,000,000	36,000,000	80,413,587
Tertiary Income	33,000,000	90,000,000	245,399,285
TOTAL INCOME	$54,000,000	$130,000,000	$329,004,937
4. POPULATION	40,000	80,000	128,000
5. % OF POPULATION IN LABOR FORCE	33%	31%	33%
6. INCOME PER EMPLOYEE			
Primary Income/Employee	$2,500	$2,000	$1,100
Secondary Income/Employee	4,000	4,500	6,020
Tertiary Income/Employee	5,500	6,000	9,630
AVER. INCOME PER EMPLOYEE	$4,500	$5,200	$7,890
7. PER CAPITA INCOME	$1,350	$1,630	$2,570
8. PRODUCTIVITY			
Primary Productivity/Employee	$3,500	$4,000	$2,040
Secondary Productivity/Employee	6,000	6,500	6,700
Tertiary Productivity/Employee	8,000	8,670	11,900
AVERAGE PRODUCTIVITY PER EMPLOYEE	$6,600	$7,600	$9,540

PROJECTIONS

NATIONAL

	Year 1	Year 2	Projected Year "X"
1. NATIONAL EMPLOYMENT			
Primary Employment	8,000	6,500	7,370
Secondary Employment	10,000	17,000	24,822
Tertiary Employment	15,000	28,000	42,720
TOTAL NATIONAL EMPLOYMENT	33,000	51,500	74,912
2. GROSS NATIONAL PRODUCT			
Primary Product	$24,000,000	$28,000,000	$29,550,210
Secondary Product	52,000,000	93,000,000	151,632,545
Tertiary Product	97,000,000	196,000,000	401,408,700
GROSS NATIONAL PRODUCT	$173,000,000	$317,000,000	$582,591,455
3. INCOME			
Primary Income	$15,000,000	$ 12,000,000	$ 10,428,080
Secondary Income	35,000,000	68,000,000	134,440,027
Tertiary Income	74,000,000	147,000,000	324,195,200
TOTAL NATIONAL INCOME	$124,000,000	$227,000,000	$469,063,307
4. NATIONAL POPULATION	110,000	165,000	231,900
5. % OF NATIONAL POPULATION IN LABOR FORCE	30%	31%	32%
6. INCOME PER EMPLOYEE			
Primary Income per Employee	$1,880	$1,850	$1,420
Secondary Income per Employee	3,500	4,000	5,430
Tertiary Income per Employee	4,940	5,250	7,590
NATIONAL AVERAGE INCOME PER EMPLOYEE	$3,760	$4,410	$6,270
7. NATIONAL PER CAPITA INCOME	$1,130	$1,380	$2,020
8. PRODUCTIVITY			
Primary Productivity/Emp.	$3,000	$4,310	$4,000
Secondary Productivity/Emp.	5,200	5,470	6,100
Tertiary Productivity/Emp.	6,470	7,000	9,430
NATIONAL PRODUCTIVITY PER EMPLOYEE	$5,250	$6,150	$7,780

EVIEW OF PROJECTIONS

EGION I - Projections in Region I followed the previous trends established by the ypothetical data for the most part. Tertiary activities are forecast to achieve the reatest gains and, again, secondary activities are expected to show moderate increases with primary activities leveling off. One significant difference shows up n respect to primary activities, however, Apparently the considerable decline etween year 1 and year 2 can be expected to be checked in terms of employment and ncome, although total product will remain about the same. Relative to the nation-l economy, this Region continues to decline in terms of percentage of the national abor force, per capita income and population. Where the region was on equal terms ith Region II in terms of Gross Regional Product in years 1 and 2, the projection ndicates the region will fall behind in this regard.

EGION II - While this region at the outset was principally an agricultural econmy, the projections indicate that it will blossom out as a major manufacturing re-ion by the year "X". A sharp rise in productivity is indicated for all activities, ut the rise in secondary activities is most pronounced. While the region has not aught up to Region I in terms of employment or income, the projections indicate hat it will actually surpass Region I in terms of regional product. (This might be omewhat analogous to the relationship of the South and New England where the shift n textiles to a low labor cost area results in greater productivity).

EGION III - The projections indicate that this region will be mushrooming by the ear "X". All phases of its economic activity is growing faster than the nation as a whole and faster than either of the other two regions. Even though it was assumed that population growth would slow down (in relative terms), this region appears to be burgeoning with economic well-being. In greater detail, however, the really dynamic part of the economy is the tertiary sector, and the only declining sector is in primary activities. In point of fact, the decline of primary activities is most pronounced in this Region with employment, total product and income all falling. With respect to the national averages, this region is growing at a faster rate. In the year 1 the Region shared in 36% of the nation's labor force. In the projected year "X" this share is expected to rise to 55%. Per capita income is rising at a faster rate than the nation and the population gains are also greater.

APPLICATION TO AN ANALYSIS OF THE BOSTON REGION

Basically, the Table on page 22 indicates the kind of answers which this analysis will provide for planning purposes. While detail refinement in terms of activity categories will not be determined, a broad overall picture of the size and distribution of the labor force will be indicated as well as the income which can be expected to be generated in the future. These results can be compared with independent projections of population, family composition, labor force, etc. and the results will provide a fairly rational forecast of the size and character of the economy in any one region. In terms of a specific region, of course, these forecasts provide for planning purposes basic data which can be utilized in further determination of planning for resource requirements, land use allocations, and needed public facilities.

As has been noted, detailed analysis of historical trends in the following variables will be involved as well as the calculations indicated here: p, r, z, VP, and P. In addition, some account should be taken of varying rates of labor force participation and cyclical occurrences when the labor force is not utilized to full capacity.